

What Is Claimed Is:

1. An axle driving system, comprising:

a housing;

5 an hydrostatic transmission disposed in said housing including an input means, a hydraulic pump driven by said input means, a hydraulic motor driven by pressurized oil from said hydraulic pump, and an output means driven by said hydraulic motor;

an axle, wherein said hydraulic pump is disposed between said hydraulic motor and said axle; and

10 a driving gear train disposed in said housing for drivingly connecting said output means of said hydrostatic transmission and said axle.

2. An axle driving system according to claim 1, further comprising:

15 a pump mounting surface for mounting said hydraulic pump provided in said housing adjacent to said axle; and

a motor mounting surface for mounting said hydraulic motor provided in said housing away from said axle;

20 wherein said hydraulic pump is mounted substantially vertically on said pump mounting surface, and said hydraulic motor is mounted substantially horizontally on said motor mounting surface.

3. An axle driving system according to claim 2, wherein a phantom plane which includes said motor mounting surface intersects the rotational axis of said hydraulic pump.

25 4. An axle driving system, comprising:

a housing;

a hydrostatic transmission disposed in said housing including an input means, a hydraulic pump driven by said input means, a hydraulic motor driven by pressurized oil from said hydraulic pump, and an output means driven by said hydraulic motor;

- 5 an axle, wherein said input means is positioned at the substantial center of the lateral width of said housing, extends vertically with respect to said axle and receives power from a prime mover; and
- a driving gear train disposed in said housing for drivingly connecting said output means of said hydrostatic transmission and said axle.

10 5. An axle driving system according to claim 4, wherein said input means is positioned at the substantial longitudinal center of said housing.

- 15 6. An axle driving system, comprising:
- a housing;
- a hydrostatic transmission disposed in said housing including an input means, a hydraulic pump driven by said input means, a hydraulic motor driven by pressurized oil from said hydraulic pump, and an output means driven by said hydraulic motor;
- an axle, wherein said input means is positioned at the substantial longitudinal center of said housing, extends vertically with respect to said axle and receives power from a prime mover; and
- a driving gear train disposed in said housing for drivingly connecting said output means of said hydrostatic transmission and said axle.

20 7. An axle driving system according to claim 6, wherein said input means is positioned at the substantial center of the lateral width of said housing.

8. An axle driving system, comprising:

a housing, wherein said housing has a first section and a second section;

5 a hydrostatic transmission disposed in said first section of said housing including an input means, a hydraulic pump driven by said input means, a hydraulic motor driven by pressurized oil from said hydraulic pump, and an output means driven by said hydraulic motor;

10 an axle, wherein said hydraulic pump is disposed between said hydraulic motor and said axle in said first section of said housing; and

15 a driving gear train disposed in said second section of said housing for drivingly connecting said output means of said hydrostatic transmission and said axle.

9. An axle driving system according to claim 8, wherein said

15 housing further comprises:

20 an inner wall partitioning said first section of said housing from said second section of said housing.

10. An axle driving system according to claim 9, wherein said housing further comprises:

25 two housing members jointed on a plane substantially parallel to said axle, wherein a plurality of inner wall portions are provided on said housing members and extend at one end toward said plane so as to overlap with each other when said housing members are joined, thereby forming said inner wall.

11. An axle driving system according to claim 8, wherein said first section of said housing and said second section of said housing are independent of each other.

12. An axle driving system according to claim 11, further comprising:

an inner wall provided in said housing partitioning said first section of said housing from said second section of said housing;

5 a bore provided in said inner wall, wherein said output means faces said second section through said bore and is connected to said driving gear train through said bore; and

an oil seal means disposed on an inner peripheral surface of said bore.

10 13. An axle driving system according to claim 12, further comprising:

an oil flow-through bore provided in said inner wall; and

an oil filter covering said oil flow-through bore;

wherein oil stored in said first section of said housing and said second section of said housing freely circulates through said oil filter.

15 14. An axle driving system according to claim 11, further comprising:

an external chamber for adjusting the volume of oil used by said hydrostatic transmission stored in said first section, wherein said external chamber is fluidly connected to one of said first section and said second section of said housing.

20 15. An axle driving system, comprising:

a housing;

25 a hydrostatic transmission disposed in said housing including an input means, a hydraulic pump driven by said input means, a hydraulic motor driven by pressurized oil from said hydraulic pump, and an output means driven by said hydraulic motor;

an axle, wherein said hydraulic pump is disposed between said axle and said hydraulic motor; and

5 a driving gear train disposed in said housing including an intermediate rotation transmitting member for drivingly connecting said output means of said hydrostatic transmission and said axle, wherein said hydraulic pump is disposed adjacent to said intermediate rotation transmitting member.

16. An axle driving system according to claim 15, wherein a rotational axis of said intermediate rotation transmitting member extends substantially perpendicular to a rotational axis of said hydraulic pump.

10 17. An axle driving system according to claim 15, wherein a rotational axis of said hydraulic pump and a rotational axis of said output means are substantially perpendicular to each other, the rotational axis of said output means extends substantially parallel to a rotational axis of said axle, and a rotational axis of said intermediate transmitting member extends substantially parallel to the rotational axis of said axle.

15 18. An axle driving system according to claim 17, further comprising:
 an output gear provided on said output means;
 a first gear and a second gear disposed on said intermediate rotation transmitting member; and
 a third gear provided on said axle;
 wherein said first gear engages with said output gear and said second gear engages with said third gear, thereby forming said driving gear train.

20 25. An axle driving system according to claim 18, wherein said second gear is disposed between said first gear and said hydraulic pump.

20. An axle driving system, comprising:

a housing;

5 a hydrostatic transmission disposed in said housing including an input means, a hydraulic pump driven by said input means, a hydraulic motor driven by pressurized oil from said hydraulic pump, an output means driven by said hydraulic motor, and a center section on which said hydraulic pump and said hydraulic motor are mounted and are fluidly connected with each other;

10 an axle; and

15 a driving gear train disposed in said housing for drivingly connecting said output means of said hydrostatic transmission and said axle; wherein said center section is separably mounted in said housing, so that a first portion is provided adjacent to said axle and a second portion is provided away from said axle, a pump mounting surface for mounting said hydraulic pump is provided on said first portion, and a motor mounting surface for mounting said hydraulic motor is provided on said second portion.

20. An axle driving system according to claim 20, wherein said pump mounting surface and said motor mounting surface are perpendicular to each other, the rotational axis of said hydraulic pump disposed on said pump mounting surface is substantially vertical, the rotational axis of said hydraulic motor disposed on said motor mounting surface is substantially horizontal, and said first portion and said second portion of said center section are coupled to each other so that the phantom plane which includes said motor mounting surface intersects said first portion.

25. An axle driving system according to claim 21, wherein the phantom plane which includes said motor mounting surface intersects a

rotational axis of said hydraulic pump disposed on said pump mounting surface.

23. An axle driving system according to claim 21, wherein said center section further comprises:

5 a pair of first kidney-shaped ports open on said pump mounting surface for receiving oil supplied or discharged into or from said hydraulic pump;

10 a pair of second kidney-shaped ports open on said motor mounting surface for receiving oil supplied or discharged into or from said hydraulic motor; and

a pair of oil passages provided in said center section for fluidly connecting said first kidney-shaped ports and said second kidney-shaped ports;

15 wherein said oil passages are positioned vertically in a thick portion of said center section.

24. An axle driving system, comprising:

a housing;

20 a hydrostatic transmission disposed in said housing-including an input means, a hydraulic pump driven by said input means, a hydraulic motor driven by pressurized oil from said hydraulic pump, and an output means driven by said hydraulic motor;

a speed changing mechanism for changing the rotational direction and rotational speed of said output means, wherein said speed changing mechanism is disposed at one side of said hydrostatic transmission;

25 an axle, wherein said hydraulic pump and said hydraulic motor are disposed substantially perpendicular to said axle; and

a driving gear train disposed in said housing for drivingly connecting said output means of said hydrostatic transmission and said axle.

5 25. An axle driving system according to claim 24, wherein said driving gear train is disposed at a side of said hydrostatic transmission opposite to said speed changing mechanism, so that said hydrostatic transmission is disposed between said speed changing mechanism and said driving gear train.

10 26. An axle driving system according to claim 24, wherein said hydraulic pump is of variable displacement type and further comprises:

15 a movable swash plate;
 a speed change shaft provided on said speed changing mechanism, wherein the rotational axis of said speed change shaft extends substantially parallel to said axle and interlocks with said movable swash plate; and

20 a neutral position return bias means provided on said speed changing mechanism for returning said movable swash plate to a neutral position.

25 27. An axle driving system according to claim 25, wherein said speed changing mechanism further comprises:

20 a control arm provided at one side of said housing and mounted onto said speed change shaft, wherein said control arm is swingable around the horizontal rotational axis thereof; and

25 a shock absorber disposed on one side surface of said housing and mounted at one end to said control arm and at an other end to said housing.

28. An axle driving system, comprising:

25 a housing;
 a hydrostatic transmission disposed in said housing including an input means, a hydraulic pump driven by said input means, a hydraulic

motor driven by pressurized oil from said hydraulic pump, and an output means driven by said hydraulic motor;

a speed changing mechanism for changing the rotational direction and rotational speed of said output means;

5 an axle, wherein said hydraulic pump and said hydraulic motor are disposed substantially perpendicular to said axle;

a driving gear train disposed in said housing for drivingly connecting said output means of said hydrostatic transmission and said axle; and

10 a brake unit provided between said output means and said axle, wherein said brake unit is disposed at one side of said hydrostatic transmission.

29. An axle driving system according to claim 28, wherein said speed changing mechanism is disposed at the side of said hydrostatic transmission opposite to said brake unit so that said hydrostatic transmission is disposed between said brake unit and said speed changing mechanism.

30. An axle driving system according to claim 28, wherein said brake unit is disposed in said housing.

31. An axle driving system according to claim 28, further comprising:

20 a brake operating shaft provided at said brake unit, wherein said brake unit is actuated by rotating said brake operating shaft around the longitudinal rotational axis thereof;

25 wherein said input means extends substantially perpendicular to said axle and the longitudinal rotational axis of said brake operating shaft extends substantially parallel to the rotational axis of said input means.

32. An axle driving system according to claim 31, wherein said brake operating shaft is rotatably supported by the upper wall of said housing in a substantially vertical position and an operating end of said brake operating shaft is disposed in said housing.

5 33. An axle driving system according to claim 32, wherein said
brake unit further comprises:

10 a brake disc provided at said brake unit and integrally rotatable with said output means, wherein a rotational axis of said brake disc intersects substantially perpendicularly with a longitudinal axis of said brake operating shaft;

15 a first friction member and a second friction member disposed opposite to a rotary surface of said brake disc, wherein said first friction member and said second friction member are supported within said housing and said first friction member is movable toward and away from the rotary surface of said brake disc;

a first cam provided on said brake operating shaft; and
a second cam provided at a rear surface of said first friction member and engageable with said first cam;

20 wherein said first cam and said second cam convert rotational motion of said brake operating shaft into linear motion of said first friction member, thereby pressing said first friction member onto said brake disc.

34. An axle driving system according to claim 33, wherein said first cam and said second cam are formed on a flat surface substantially parallel to said rotary surface of said brake disc.

25 35. An axle driving system according to claim 33, wherein said second friction member is adjustable from the exterior of said housing toward and away from said rotary surface of said brake disc.